INSTRUCTIONS

FUEL INJECTION SYSTEM ENGINE-MOUNTED ITEMS
(LARGE FUEL SYSTEM)

CONTENTS

	Page	Allied Pub.
FUEL OIL FILTERS		
ELEMENT CLEANING AND CHANGING	1	
ENGINE DRAIN SYSTEM	2	
SYSTEM PRIMING	2	
RELIEF VALVE		
ADJUSTMENT	2	
MAINTENANCE	3	
REGULATING VALVE		
ADJUSTMENT	3	
MAINTENANCE	3	
FUEL INJECTION PUMP		GEK-35872
PUMP REMOVAL	3	AND
PUMP INSTALLATION	4	GEK-18175
PUMP VARIATIONS	5	
PUMP TIMING WITH BARRING-OVER HUB	6	
PUMP TIMING WITH BARRING-OVER GOVERNOR DRIVE	7	
FUEL INJECTOR NOZZLE		GEK-18173
NOZZLE REMOVAL	8	
NOZZLE INSTALLATION	9	
DATA	10	
LOCO. FUEL OIL SYSTEM (See ME-7)		GEK-18154
FUEL INJ. MAINT.—FACIL. AND EQUIP.		GEK-18177
FUEL OIL TRANSFER PUMP SET (See RE-5)		GEK-35848

FUEL OIL FILTERS

The fuel injection equipment is protected from foreign material by a fuel-oil strainer and filter. On FDL16 engines, the strainer and filter are located on the right side of the engine near the fuel booster pump. On FDL12 engines, the strainer is located on the right side of the engine and the filter is located on the left side of the engine. On FDL8 engines, the strainer and filter are located on the left side of the engine.

The fuel strainer assembly consists of a fabricated-steel can housing a single, fine mesh, monel-wire screen element. The strainer is connected to the suction side of the booster pump, and removes relatively large particles of foreign matter from the fuel before the fuel reaches the pump.

The fuel filter assembly consists of a large steel can which houses a single large filter element. The filter is pipe-connected to the booster-pump fuel discharge opening.

ELEMENT CLEANING AND CHANGING

A gradual drop in fuel flow and header pressure indicates the fuel strainer or the fuel filter has become restricted and should be either cleaned or replaced.

Fuel Strainer

To remove and clean the strainer element:

1. Remove the drain plug from the strainer housing to drain the housing.
2. Loosen the wing nuts on the strainer cover, and remove the strainer element.
3. Remove the rubber grommet from the end of the strainer element. Flush the element in a cleaning solution, and blow it dry with clean air.
4. Flush out the strainer housing with clean fuel oil, and blow it dry with clean air.
5. Inspect the rubber grommet and the rubber O-ring in the housing under the strainer cover. If either item is damaged, install a new one.
6. Install the grommet in the strainer element, and replace the cleaned element.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

Verify numbers for parts, tools, or material by using the Renewal Parts or Tool Catalogs, or contact your General Electric representative for assistance. Do not order from this publication.

GENERAL ELECTRIC

7. Replace the drain plug, and fill the strainer shell with clean fuel oil.
8. Replace the strainer cover, and tighten the cover wing nuts evenly and carefully.

Fuel Filter

When conditions indicate that the fuel filter should be replaced:

1. On older engines, drain the filter by removing the drain plug located at the bottom lower end of the filter housing. On engines built since early 1974, open the spring-loaded drain valve which allows fuel oil to drain to the tank, Fig. 1.
2. Loosen the cover clamping bolt and, after the housing has drained, remove the cover from the housing.
3. Remove the filter element.
4. Thoroughly flush the filter housing with clean fuel oil, and blow it dry with clean air. Inspect the rubber O-ring in the housing under the cover. If it is damaged in any way, replace it with a new O-ring.
5. Install the drain plug and insert a new filter element. Use a GE renewal parts element with cover marked, "FUEL OIL ONLY." Apply a film of lube oil to the element O-ring to prevent O-ring damage during assembly.
6. Replace the cover and tighten the cover bolt.

ENGINE DRAIN SYSTEM

A slight leakage of fuel from the injection pump and the fuel injector nozzle on each power cylinder is normal, since this is required to lubricate the pump and nozzle parts. The fuel leakage must then be drained to the fuel tank.

A system of passages within each cylinder assembly conducts leakage fuel through the upper portion of the cylinder, around the base of the injection pump, and downward through the pump push-rod cavity. Fuel is drained from each injector cavity to the return passage.

A passage in each cylinder base is aligned with drilled passages within the engine main frame. A fuel-drain-header pipe is attached to each side of the engine main frame and connected to each of these passages to collect drainage fuel. Each header pipe is constructed with an open standpipe at one end. The other end is connected to return drainage fuel to the fuel tank.

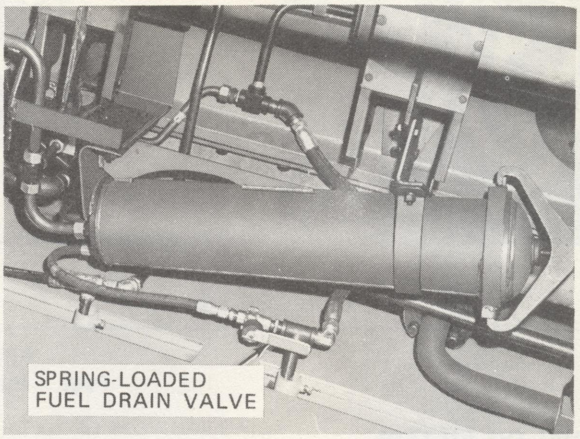


FIG. 1. TYPICAL FUEL DRAIN VALVE ARRANGEMENT.

FIG. 1, E-25377

The fuel drain system must remain free of obstructions to permit gravity flow of fuel to the tank. If the system should become clogged, fuel dilution of the lubricating oil will occur.

SYSTEM PRIMING

Normally it is not necessary to prime the fuel system, as the regulating valve will vent the system when the booster pump is started. However, it is good practice when cleaning and replacing the fuel strainer element to fill the strainer can with clean fuel after installing the element. This will assure against pump damage due to insufficient lubrication during initial start and will allow quicker priming of the system.

RELIEF VALVE

A relief valve is located in the fuel system between the booster pump discharge and the filter. It is set to open at 75-psi pressure and return bypassed fuel to the main fuel tank. The valve protects the booster pump motor against electrical overloading and protects the system against excessive pressure caused by clogged filters or fuel flow stoppage in the pressure side of the system.

ADJUSTMENT

1. Install a calibrated 100-psi test gage at the test point, Fig. 2.
2. Cap-off the fuel header after it leaves the rear right injection pump.
3. Start the booster pump and observe the test pressure gage, which should read 75 psi. (Battery voltage should be approximately 64 volts.)

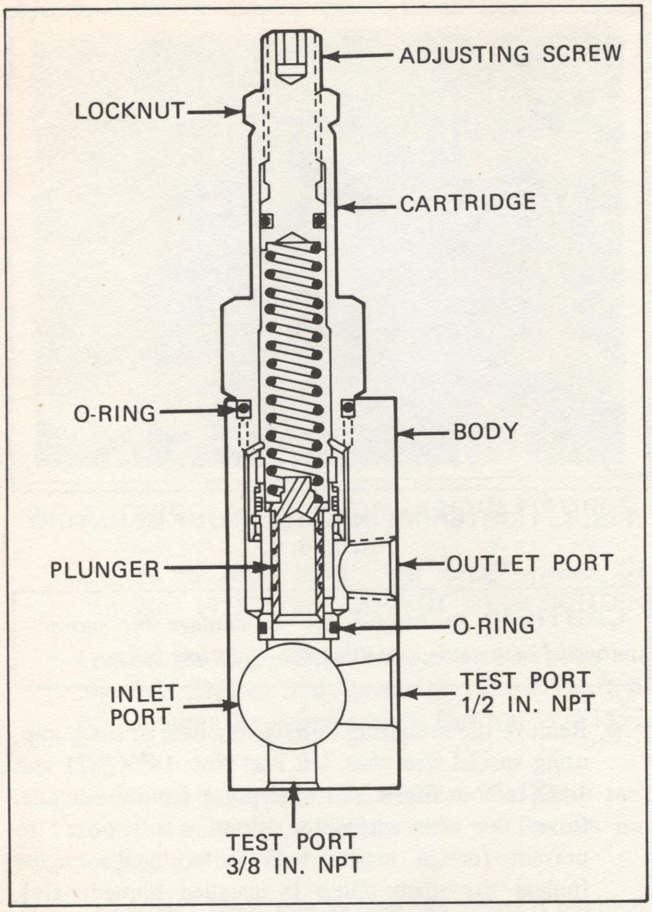


FIG. 2. RELIEF AND REGULATING VALVE.

FIG. 2, E-17740

4. To correct the valve setting, loosen the adjustment locknut, and turn the adjusting screw IN to raise the pressure. Turn the screw OUT to lower the pressure.

5. Tighten the locknut. Check the gage reading and stop the booster pump.

6. Remove the test gauge and restore the piping to normal.

MAINTENANCE

If the valve malfunctions, remove the cartridge from the body. DO NOT DISCONNECT PIPING TO THE BODY. Working through the bottom of the cartridge, check for free movement of the cartridge plunger. If necessary, replace O-rings or the entire cartridge and readjust the valve. See Adjustment section.

REGULATING VALVE

A pressure-regulating valve is located in the system between the engine header and the fuel-tank return line. It is set to maintain the fuel header pressure, which is measured at the test point or on the gage in the operator's cab. Pressure should be 38-42 psi at IDLE speed, and may drop from 4-15 psi at MAX speed and FULL LOAD, depending on the horsepower rating of the engine. When setting the fuel-header pressure, the fuel-strainer element must be clean, the filter must be clean, and the fuel in the system must be free of air bubbles.

When the fuel-header pressure drops slowly over a period of time, it is usually a condition of a clogged strainer or fuel filter, rather than an incorrect setting of the pressure-regulating valve. The strainer element should be cleaned and the filter element replaced. Then, if necessary, adjust the pressure-regulating valve as described under Adjustment section.

ADJUSTMENT

1. Install a calibrated 100-psi test gage at the test point, Fig. 2.

NOTE: *Be sure the fuel strainer element has been cleaned and a new element has been installed in the filter housing.*

2. Start the booster pump and engine. With the engine operating at idle speed, read the pressure indicated on the test gage. It should read approximately 38 to 42 psi.

3. Loosen the adjustment locknut. Adjust the screw to set the pressure. Turn the screw IN to raise the pressure or OUT to lower the pressure.

4. Tighten the adjustment locknut. Check the gage reading.

5. Stop the engine and booster pump, remove the test gage, and replace the pipe plug.

MAINTENANCE

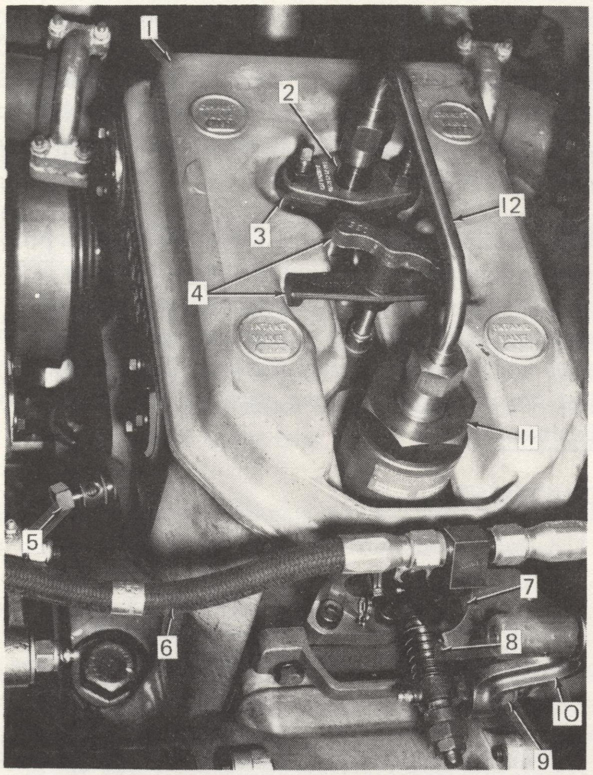
If the valve malfunctions, remove the cartridge from the body. DO NOT DISCONNECT PIPING TO THE BODY. Working through the bottom of the cartridge, check for free movement of the cartridge plunger. If necessary, replace the entire cartridge and readjust the valve. See Adjustment section.

FUEL INJECTION PUMP

Refer to Fuel Injection Pump instructions, GEK-18175 or GEK-35872.

PUMP REMOVAL (See Fig. 3)

1. Remove the cylinder-head cover.



REF.	DESCRIPTION
1	CYLINDER-HEAD COVER
2	FUEL INJECTOR
3	FUEL-INJECTOR CLAMP
4	COVER CLAMP
5	COMPRESSION RELEASE
6	FUEL HEADER LINE
7	TEE CONNECTION
8	ADJUSTABLE LINK
9	FULCRUM NUT
10	BELLCRANK
11	FUEL-INJECTION PUMP
12	HIGH-PRESSURE LINE

FIG. 3. UPPER CYLINDER DETAILS.

FIG. 3, E-17742

2. Remove the fulcrum nut; then remove the adjustable link which connects the pump rack to the bellcrank.

3. Clean the high-pressure line with a stiff bristle brush and fuel oil before disconnecting.

4. Remove the high-pressure line between the pump and injector. Cover all openings with threaded or plastic caps.

5. Disconnect the tee connection between the fuel-header lines and the pump at the pump. Cover the tee connection after the fuel has drained from the header. Apply a plastic plug to the inlet connection of the pump.

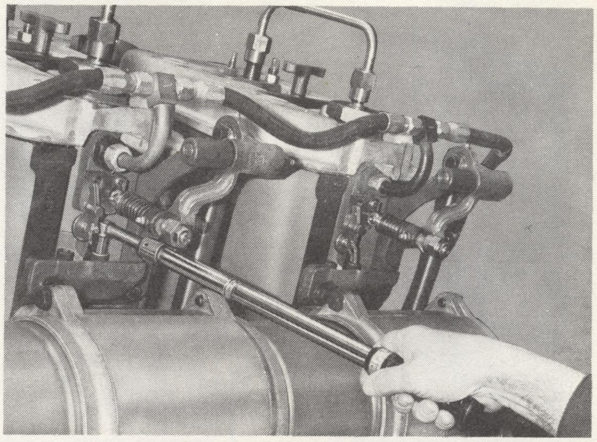


FIG. 4. TIGHTENING INJECTION PUMP MOUNTING BOLTS.

FIG. 4, E-22628

CAUTION: *Be careful not to damage the pump control rack while loosening the mounting bolts.*

6. Remove the mounting bolts at the base of the pump, using special wrenches, GE Part Nos. 147X2021 and 147X1497-2, Fig. 4. Lift the pump from the engine. Cover the area where the pump was removed to prevent foreign matter from entering the engine (unless the spare pump is installed immediately).

PUMP INSTALLATION

CAUTION: *Before installing pumps on the engine, shorten the tappet-rod length. Remove the cover at the bottom of the cylinder, Fig. 6. LOOSEN THE LOCKNUT AND TAPPET NUT, USING TWO OPEN-END WRENCHES, 15/16 AND 1-1/16. Turn the tappet adjusting nut four or five full turns clockwise. Excessive tappet-rod travel can damage the pump and tappet-rod assembly.*

NOTE: *When installing a pump, be careful that no dirt or foreign matter enters the fuel-oil lines, connections, or the engine. Keep the plugs or seals in place until the connections are to be made.*

1. Install the pump in the cylinder, using a new O-ring around the base, and tighten the mounting bolts to 45-50 lb.-ft. of torque. Use special wrenches, GE Part Nos. 147X2021 and 147X1497-2, Fig. 4.

2. Torque the 1-5/16 in. hex. adapter fitting to 90-100 lb.-ft. Connect the tube from the fuel header to the adapter fitting. Replace the damaged ferrule as required. Torque the 1 in. hex. nut to 40-45 lb.-ft. Nuts on each end of the fuel jumper hoses should be

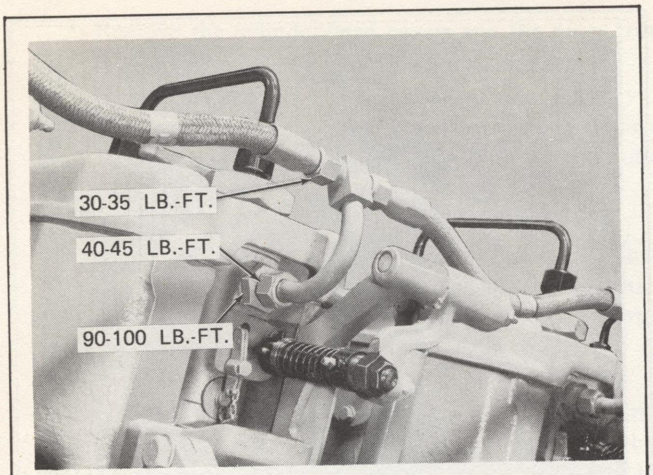


FIG. 5. TORQUE VALUES FOR VARIOUS FITTINGS.

FIG. 5, E-23396

torqued to 30-35 lb.-ft. Use special wrench, GE Part No. 147X1594. DO NOT OVERTIGHTEN.

3. Connect the high-pressure line between the pump and injector. Tighten both nuts with 140-150 lb.-ft. of torque, using the special wrench, Part No. 147X1595, Fig. 16.
4. Install the adjustable link between the pump rack and the bellcrank. Secure with the fulcrum nut torqued to 30-35 lb.-ft.
5. Check the pump rack setting and adjust if required. Refer to DE-9, Overspeed and Fuel Control Device instruction.
6. Check the pump timing. Refer to the appropriate PUMP TIMING section.

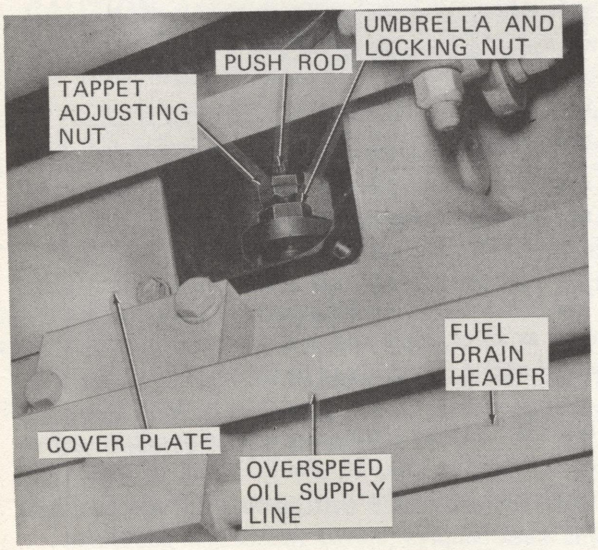


FIG. 6. FUEL INJECTION PUMP TAPPET ROD ADJUSTMENT.

FIG. 6, E-9979A

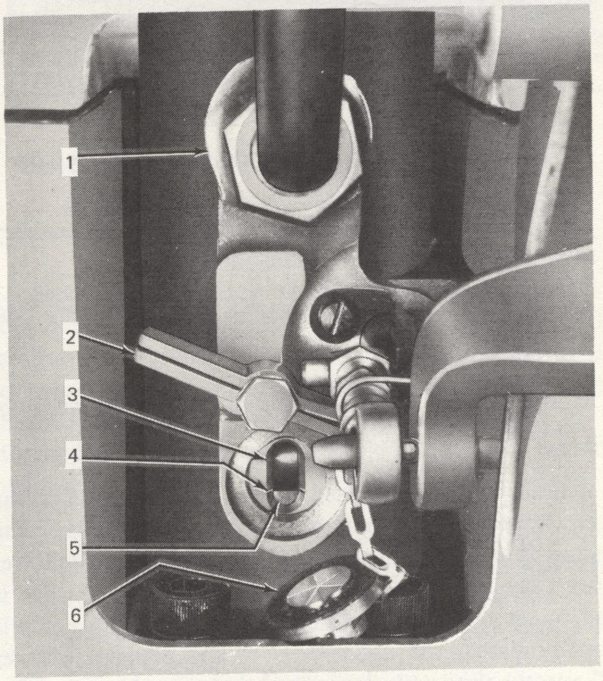
7. Replace the cylinder-head cover.

PUMP VARIATIONS

Several types of fuel injection pumps are in use on GE engines. There is, however, only one major difference with respect to timing. All Bendix pumps and all Bosch pumps applied prior to early 1978 have a short plunger follower. Any of these pumps is correctly timed when the top of the plunger follower is aligned with the scribed lines in the pump timing window, Fig. 7.

Beginning in early 1978, Bosch pumps use a long plunger follower. A pump of this type is correctly timed when the scribed line on the side of the plunger follower aligns with the scribed lines in the timing window, Fig. 8.

It should be noted that the plunger follower in the later Bosch design will be visible even when the plunger follower is at its lowest position. This is not true of the other style of pump.



REF.	DESCRIPTION
1	INJECTION PUMP
2	PLUG CLAMP BAR
3	TIMING WINDOW
4	SCRIBE LINES
5	PLUNGER FOLLOWER
6	TIMING WINDOW PLUG

FIG. 7. CORRECTLY-TIMED BENDIX PUMP OR BOSCH PUMP WITH SHORT PLUNGER FOLLOWER.

FIG. 7, E-9973

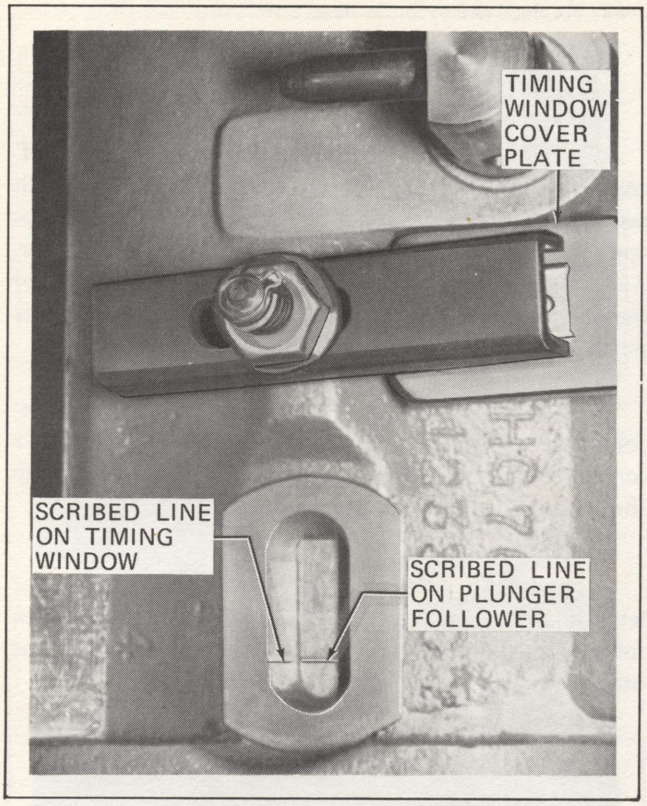

TIMING WINDOW COVER PLATE
SCRIBED LINE ON TIMING WINDOW
SCRIBED LINE ON PLUNGER FOLLOWER

FIG. 8. CORRECTLY-TIMED BOSCH PUMP WITH LONG PLUNGER FOLLOWER.

FIG. 8, E-24779

PUMP TIMING WITH BARRING-OVER HUB

When timing the fuel injection pumps, it is necessary to refer to the following indicating marks:

1. The scribed lines at the pump timing window, Figs. 7 and 8.
2. The SET marks on the face of the barring-over hub, Fig. 9.

A timing window, covered with a plug, is located on the lower outside of the pump housing. Each side of the window is scribed with a timing line. The plunger follower appears behind the timing window, and its upper edge is used to set the pump timing, Fig. 7. When the pump is properly timed, the upper edge of the plunger follower will exactly align with the scribed timing marks at the edge of the pump window.

The barring-over hub is located at the free end of the engine and is marked with pump SET marks. Two numbers are stamped adjacent to each mark, and they refer to pairs of cylinders. Marks found on barring-over hubs are:

For 16-cylinder engines:	1-8, 3-6, 2-7, and 4-5
For 12-cylinder engines:	1-6, 2-5, and 3-4
For 8-cylinder engines:	1-4, and 2-3.

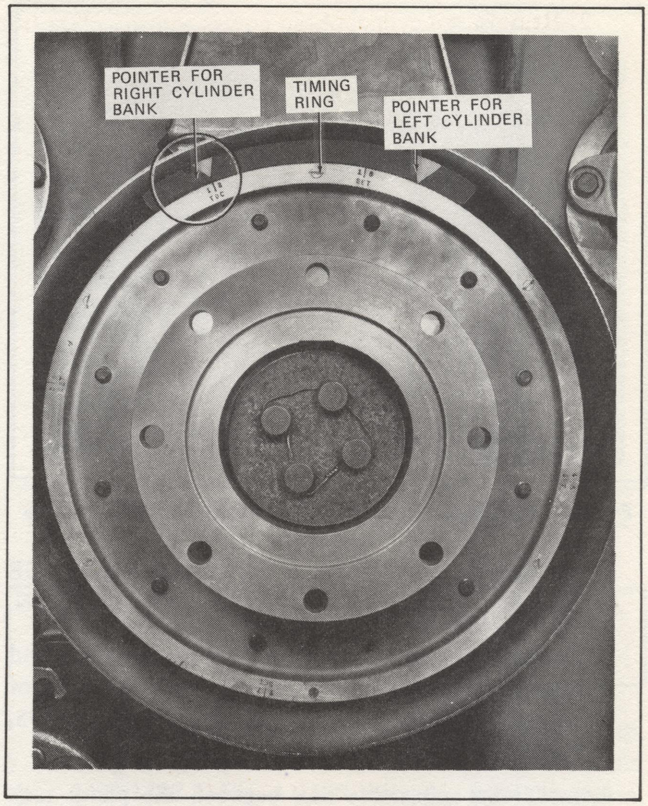

POINTER FOR RIGHT CYLINDER BANK
TIMING RING
POINTER FOR LEFT CYLINDER BANK

FIG. 9. FUEL-PUMP SET MARKS ON BARRING-OVER HUB.

FIG. 9, E-9981

There are two indicating pointers mounted above the timing ring. One pointer indicates timing for right-bank cylinders and the other for left-bank cylinders.

The pointer in line with each cylinder bank indicates the timing for that bank.

NOTE: *Use care not to confuse the 1-8, 1-6, or 1-4 TDC mark with the 1-8, 1-6, or 1-4 SET mark.*

CAUTION: *Incorrect pump timing can cause excessive pump plunger travel, which may result in severe damage to the pump.*

The No. 1 right cylinder pump for a 16-cylinder engine is used as an example and is a good starting point to use when all engine pumps are to be timed.

NOTE: *Tappet settings on inlet and exhaust valves of a cylinder can be checked and, if necessary, readjusted while the fuel pump on the cylinder is being timed.*

1. Back off the compression-release plugs one full turn on all cylinders.

FIG. 10, E-23484

2. Remove the cylinder-head covers and the plugs from the fuel-pump timing windows.

3. Remove the covers which seal the pump tappet-rod compartment near the bottom of each cylinder, Fig. 6.

4. Using the barring-over tool, slowly bar the crankshaft over in its direction of rotation until the timing mark 1-8 SET exactly aligns with the right-bank pointer, Fig. 9.

5. Assure all valves are closed on the 1-R cylinder (firing stroke). If the valves are closed, a small amount of free movement will be noted by manually moving the rocker arms. Another check is to observe the radial position of the fuel and valve cams for the particular cylinder. If the cylinder is on its firing stroke, the valve cross-head rollers will be off the lobe and on the base circle of the cam. The fuel cross-head roller will be rising on the lobe of its cam.

6. If the valves are not closed, rotate the crankshaft one more revolution in the direction of rotation. Stop on the 1-8 SET mark, and recheck the valves.

7. Adjust the fuel-pump tappet nut on the 1-R cylinder until the top edge of the plunger follower is exactly aligned with the scribed marks on the sides of the fuel-pump timing window, Fig. 7.

8. Lock the tappet nut securely and recheck the alignment of the pump timing marks.

CAUTION: *Use two wrenches, when tightening: 1-1/16 in. on the umbrella locknut, and 15/16 in. on the tappet nut. Failure to do so will cause over-torquing against the guide pin of the tappet rod. This will distort or damage the bronze tappet guide.*

If they are correct, proceed with the pump on the 1-L cylinder. Again using the 1-8 SET mark, turn the crankshaft until the mark is exactly aligned with the left-bank pointer.

9. Proceed to the next cylinder in the firing order, and repeat until all have been timed. Be sure each tappet nut is locked before leaving it.

10. After all the pumps have been timed, replace the tappet-rod adjustment covers, cylinder-head covers, and fuel-pump timing-window plugs. Remove the barring-over tool. Tighten the compression-release plugs.

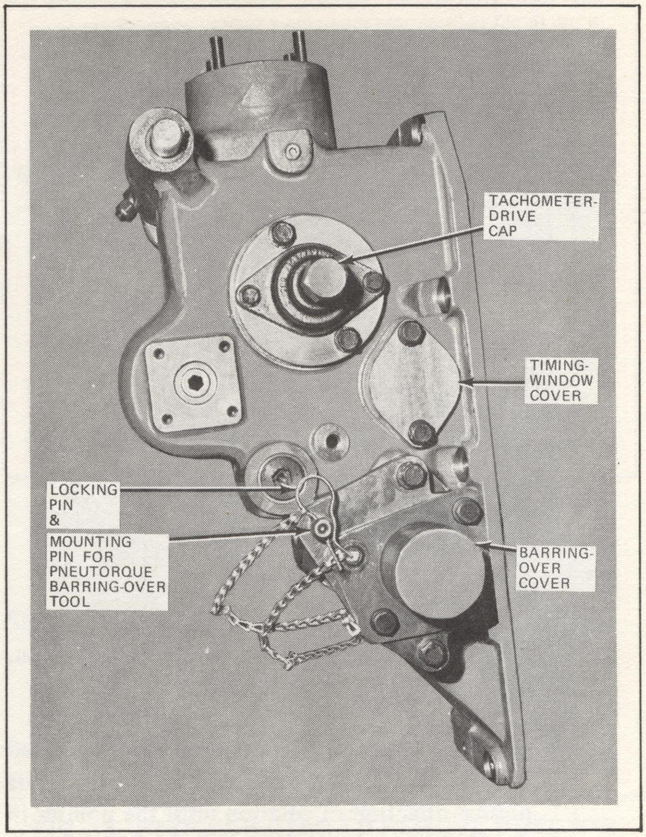


FIG. 10. ASSEMBLED GOVERNOR DRIVE, FORWARD SIDE.

PUMP TIMING WITH BARRING-OVER GOVERNOR DRIVE

Since mid-1976, most engines have been produced with the barring-over governor drive. Refer to GEK-61340 in section DE-5. When this drive is used, there is no barring-over hub, with set marks, on the forward end of the engine; instead these two functions are accomplished at the forward side of the governor drive, Fig. 10, in the following manner:

1. Remove the timing-window cover and the barring-over cover from the governor drive. This will expose timing (degree) marks on the forward side of the camshaft gear and the barring-over gear with a 1-in. square drive insert, Fig. 11.

2. Move the barring-over gear inward into engagement with the camshaft gear. Then apply either a ratchet wrench or an air-operated wrench to the barring-over gear to facilitate barring-over the engine, Figs. 12 and 13.

CAUTION: *The use of an impact wrench is not recommended for this operation, since internal damage may result.*

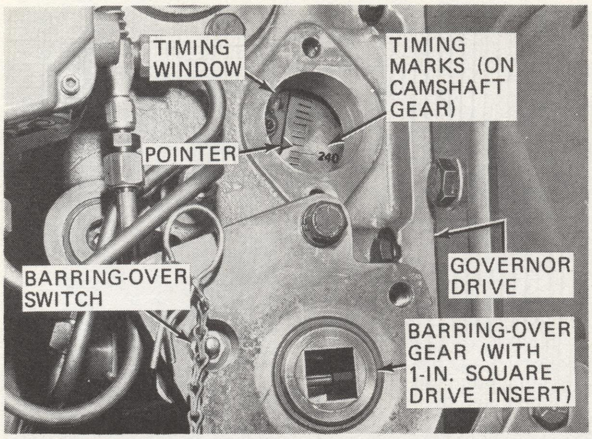

TIMING WINDOW
TIMING MARKS (ON CAMSHAFT GEAR)
POINTER
240
BARRING-OVER SWITCH
GOVERNOR DRIVE
BARRING-OVER GEAR (WITH 1-IN. SQUARE DRIVE INSERT)

FIG. 11. GOVERNOR DRIVE WITH COVERS REMOVED.

3. Follow the instructions outlined under PUMP TIMING WITH BARRING-OVER HUB section, Steps 1 thru 10, with the following exception:

   a. Step 4 – Use the ratchet wrench or air-operated wrench, and slowly bar the engine over in its normal direction of rotation until the pointer in the timing window aligns with the 348.5-degree line. Refer to Figs. 11 and 14.

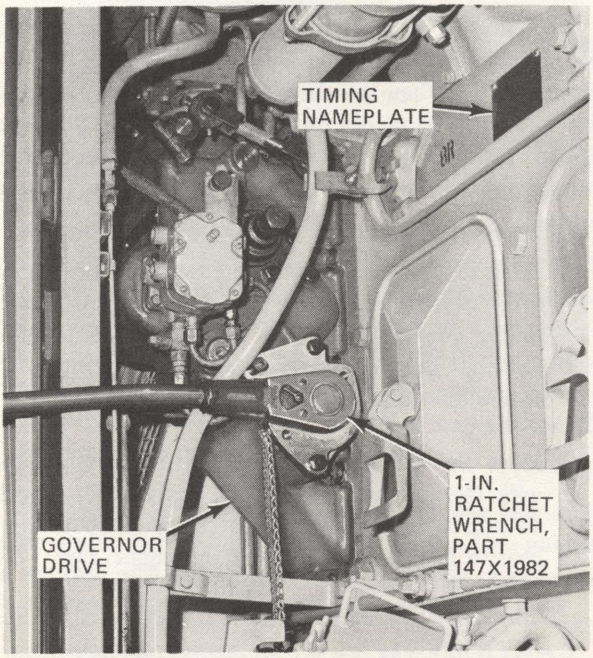

TIMING NAMEPLATE
GOVERNOR DRIVE
1-IN. RATCHET WRENCH, PART 147X1982

FIG. 12. BARRING-OVER ENGINE USING A 1-IN. RATCHET WRENCH.

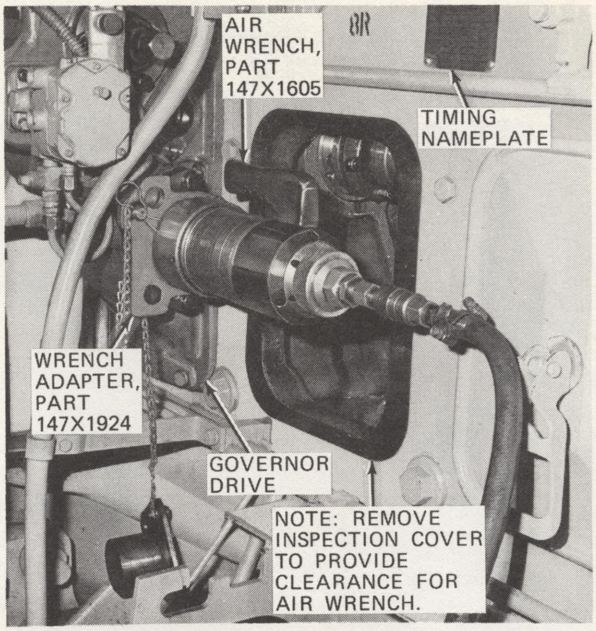

AIR WRENCH, PART 147X1605
TIMING NAMEPLATE
WRENCH ADAPTER, PART 147X1924
GOVERNOR DRIVE
NOTE: REMOVE INSPECTION COVER TO PROVIDE CLEARANCE FOR AIR WRENCH.

FIG. 13. BARRING-OVER ENGINE USING THE PNEUTORQUE AIR WRENCH.

   b. Step 5 – While this operation is not mandatory, it is recommended since it assures the integrity of the camshaft assemblies and the engine firing order.

   c. Step 6 – Omit this operation; having the timing (degree) marks on the camshaft (instead of the crankshaft) assures timing on the firing stroke.

FUEL INJECTOR NOZZLE

Refer to Fuel Injector Nozzle instructions, GEK-18173.

NOZZLE REMOVAL

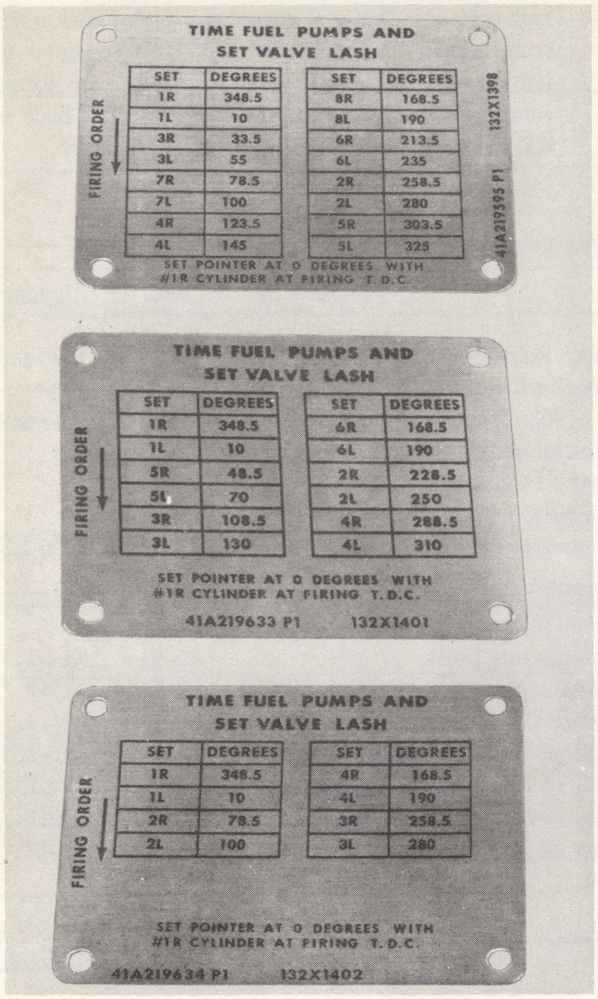
1. Remove the cylinder-head cover.
2. Clean the high-pressure line with a stiff bristle brush and fuel oil before disconnecting.
3. Remove the high-pressure line between the pump and nozzle. Cover all openings with threaded or plastic caps.
4. Remove the two nuts which secure the nozzle clamp.
5. Remove the fuel injector nozzle from the cylinder head. Use the knocker, Part No. 147X1856, to facilitate removal, Fig. 15.

FIG. 11, E-24341

FIG. 12, E-24342

FIG. 13, E-24343

FIG. 14, E-24344



TIME FUEL PUMPS AND
SET VALVE LASH

FIRING ORDER

SET	DEGREES	SET	DEGREES
1R	348.5	8R	168.5
1L	10	8L	190
3R	33.5	6R	213.5
3L	55	6L	235
7R	78.5	2R	258.5
7L	100	2L	280
4R	123.5	5R	303.5
4L	145	5L	325

SET POINTER AT 0 DEGREES WITH
#1R CYLINDER AT FIRING T.D.C.

41A219595 P1 132X1398

TIME FUEL PUMPS AND
SET VALVE LASH

FIRING ORDER

SET	DEGREES	SET	DEGREES
1R	348.5	6R	168.5
1L	10	6L	190
5R	48.5	2R	228.5
5L	70	2L	250
3R	108.5	4R	288.5
3L	130	4L	310

SET POINTER AT 0 DEGREES WITH
#1R CYLINDER AT FIRING T.D.C.

41A219633 P1 132X1401

TIME FUEL PUMPS AND
SET VALVE LASH

FIRING ORDER

SET	DEGREES	SET	DEGREES
1R	348.5	4R	168.5
1L	10	4L	190
2R	78.5	3R	258.5
2L	100	3L	280

SET POINTER AT 0 DEGREES WITH
#1R CYLINDER AT FIRING T.D.C.

41A219634 P1 132X1402

FIG. 14. TIMING NAMEPLATES FOR 8, 12 AND 16 CYLINDER ENGINES.

CAUTION: *Handle the fuel injector nozzle with care and take measures to prevent dirt from entering the nozzle. DO NOT BUMP THE TIP. Place protective plastic caps or plugs over connections and put a protective cover over the tip end. RETURN INJECTORS FOR REPAIR PROTECTED IN THE SAME MANNER AS NEW NOZZLES ARE RECEIVED.*

NOZZLE INSTALLATION

1. If difficulty is encountered in removing a fuel injector nozzle from the cylinder, the nozzle recess in the cylinder head is probably encumbered with carbon, scale, etc. This must be cleaned before installing a new nozzle. This may be done in the following manner:

FIG. 15, E-19803

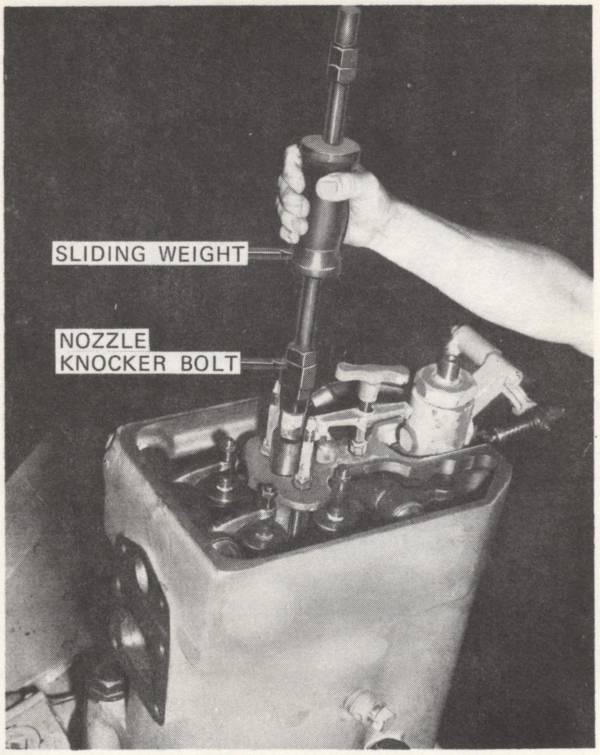


FIG. 15. KNOCKER USED TO REMOVE INJECTOR FROM CYLINDER.

   a. Use a 1-in. diameter cup wire brush (0.020-in. diameter wire) on a 15-in. extension, driven by a portable power drill.

   b. The entire length of the recess should be cleaned, but the seat is of particular importance.

   c. If it is necessary to clean the recess with the cylinder on the engine, be sure the valves are closed and the cylinder-head cover is in place.

   d. Apply air pressure through the compression-release hole to blow dirt up through the recess, instead of allowing it to fall down on the face fit and into the cylinder.

2. Place a new copper gasket on the small end of the nozzle. A small amount of grease can be used to hold the gasket in place.

3. Insert the small end of the nozzle into the recessed port. Orient the fuel drain, and place the clamp over the nozzle and studs.

4. Apply self-locking nuts and tighten them to 30-35 lb.-ft. of torque.

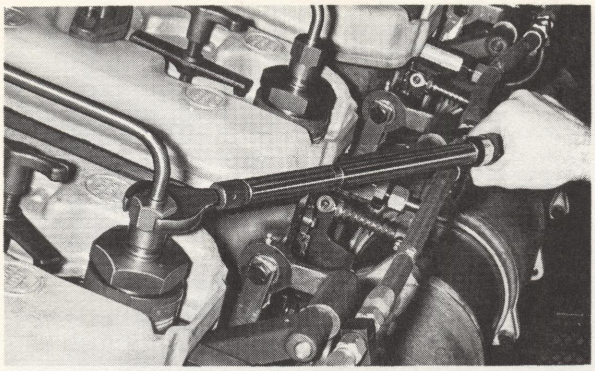


FIG. 16. TIGHTENING HIGH-PRESSURE LINE NUTS.

FIG. 16, E-22629

> **CAUTION:** *Proper tightening of the nozzle clamp nuts is important. If they are not tight enough, the exhaust gases will cause a carbon build-up between the fuel injector nozzle and recess, causing the nozzle to be bound in place. If the clamp nuts are tightened excessively, parts of the nozzle assembly will become distorted, causing the nozzle valve to leak. Excessive tightening of these nuts can also cause cracks to develop between the nozzle recess and valve-seat bores of the cylinder head and, in extreme cases, can result in unseating of the exhaust and inlet valves.*

5. Remove the protective caps from the ends of the high-pressure line and from the pump and nozzle connections. Apply the high-pressure line, and tighten the nuts with 140-150 lb.-ft. of torque. Assure no dirt gets into the connection. Check for leaks at these points when the engine is started.

DATA

Valve Settings	English	Metric	
	psi	kPa	kg/cm^2
Pump Relief Valve . . .	74-76	510-524	5,20-5,34
Pressure Regulating Valve			
at Idle Speed	38-42	262-290	2,67-2,95
at Maximum Speed and Full Load (varies with engine horsepower)	25-36	172-248	1,76-2,53

Torque Values	lb.-ft.	N·m
Injection Pump		
Mounting Bolts	45-50	61-68
Fulcrum Nut	30-35	41-47
Nozzle Clamp Nuts	30-35	41-47
High-pressure Line Nuts	140-150	190-203
1-15/16 Hex Adapter Fitting . . .	90-100	122-136
1 In. Hex Nut	40-45	54-61
Nuts on Fuel Jumper Hoses . . .	30-35	41-47

NOTES: